

## 6.4: Present Values of Annuities

**Example.** Suppose we wish to invest a lump sum of money,  $A_n$ , into an annuity that earns interest at a rate of 10% per year, so that we may receive payments of \$100 for 5 years. What is the amount of the lump sum?

### Definition.

If a payment of  $\$R$  is to be withdrawn at the *end of each period* for  $n$  periods from an account that earns interest at a rate of  $i$  per period, then the account is an **ordinary annuity** and the **present value** is

$$A_n = R \cdot a_{\overline{n}|i} = R \left[ \frac{1 - (1 + i)^{-n}}{i} \right]$$

The notation  $a_{\overline{n}|i}$  represents the present value of an ordinary annuity of \$1 per period for  $n$  periods with an interest rate of  $i$  per period.

**Example.** Find the lump sum that one must invest in an annuity to receive \$1000 at the end of each month for the next 16 years, if the annuity pays 9% compounded monthly.

**Example.** Suppose that a couple plans to set up an ordinary annuity with a \$100,000 inheritance they received. What is the size of the quarterly payments they will receive for the next 6 years if the account pays 7% compounded quarterly?

**Example.** An inheritance of \$250,000 is invested at 9% compounded monthly. If \$2500 is withdrawn at the end of each month, how long will it be until the account balance is \$0?

**Definition.**

If a payment of  $\$R$  is to be withdrawn at the *beginning of each period* for  $n$  periods from an account that earns interest at a rate of  $i$  per period, then the account is an **annuity due** and the **present value** is

$$A_{(n,\text{due})} = R \cdot a_{\overline{n}|i}(1+i) = R \left[ \frac{1 - (1+i)^{-n}}{i} \right] (1+i)$$

The notation  $a_{\overline{n}|i}$  represents the present value of an ordinary annuity of \$1 per period for  $n$  periods with an interest rate of  $i$  per period.

**Example.** Suppose that a court settlement results in a \$750,000 award. If this is invested at 9% compounded semiannually, how much will it provide at the *beginning* of each half-year for a period of 7 years?